Janurary 15 ,2003

Submitted via EFCS

Marlene H. Dortch, Secretary
Federal Communications Commission.
Office of the Secretary
455 12th Street, SW
Washington, DC 20554

Re: MM Docket 99-325
Digital Audio Broadcasting Systems and
Their Impact on Terrestrial Broadcasting

Subject: Reply to Opposition to Petition for Reconsideration.

Dear Mrs. Dortch:

I am replying in Opposition to the Petition for Reconsideration submitted by Garvey, Schubert, Barer on behalf of Glen Clark & Associates. I am strongly opposed to this Petition for Reconsideration and considering the present state of the world situation, implementing an experimental digital transmittion system at this time that has the potential to disrupt the primary long range delivery system of news and emergency information could prevent those who need this information from receiving it.

Introduction

It has yet to be determined what the full impact the digital IBOC sidebands will have on nighttime analog broadcasting via skywave interference and while numerous computer models have been done every situation cannot be simulated by computer modeling. The AM markets on the East Coast of the U.S. and other highly populated metropolitan areas are very congested and the interference issues that plagued good reception behooved the reduction of bandwidth to ±10.2KHz and set a fixed pre-emphasis to help overcome overcrowding which has come to be known as the NRSC mask and equilization. Applying the ±10.2KHz frequency limitation pretty much eliminated the 2nd adjacent channel interference problem and while this helped to bring the background noise down to somewhat accepeptable levels in most cases for 1st adjacents, it shows that these AM markets can't afford any increase in background noise especially at night. While IBOC testing has been ran on a few stations at night it cannot be a good representation of the effects that many IBOC stations will have in markets like these. The characteristic of an IBOC signal has a continious level across the occupied spectrum and the closest description is a white noise type of signal. For some who have heard the IBOC sidebands on an analog radio have come to refer to this IBOC hash as a "continious wave of white noise".

Preliminary IBOC Nighttime Testing

The levels of the primary IBOC sidebands originally proposed by iBiquity were at ~-29dBc and while this is below the -25dBc NRSC limit for the ±10.2KHz to ±20KHz range for normal program material the primary IBOC sidebands need to be reduced to at least -36dBc in order to meet the more restrictive mask limitations for white noise as defined by the dotted line in the familar graph for the NRSC mask. In earlier IBOC field tests engineers from one of the larger broadcast comglomerates determined that the sidebands needed to be reduced by at least 6dB to reduce interference to adjacent stations but this will not be enough when many IBOC transmittions commence in a conjested area for nighttime operation. Reducing the sidebands by 6dB of what iBiquity initially recomended and given that most transmitter antennas are not perfectly flat in response will most likely bring these sidebands within compliance of the more restrictive mask for white noise. While using this 6dB reduction the few tests that have been done at night did not provide enough protection to 1st and 2nd adjacent stations in some cases. It should be pointed out that this more restrictive mask for white noise was only meant to measure the test emissions of a stations transmitter performance under this type of test signal and most likely was not intended for a station to transmitt this type of signal as regular program material. If the Commission at the time of approving the NRSC mask had any idea that a station would use this type of siganl for regular program material this mask for white noise probably would have been set more restrictive.

Analisys of the AM IBOC signal

Most of iBiquity's measurements for interference to analog radios were based on narrow band models wide enough to convey an intelligable voice signal and the average narrow band radio's response is usually down by ~-20dB at 5KHz. According to the "AM All Digital Report" published by iBiquity the graph of the sidebands for the composite siganl which contains both analog and digital components shows the level of the analog signal to be at ~-8.5dBc, the secondary sidebands at ~-41dBc, and the tertiary digital signal that occupies the same bandwidth as the analog component is at ~-50dBc. Given that the tertiary digital component is transmitted in quadrature to the analog component this can offer an additional minimum protection of 20dB and is what has been observed in the channel separation of a QuAM type transmittion on the AM band under a worst case senario. In theory the structure of the IBOC signal in hybrid mode demonstrates that it offers a large protection ratio to its analog component. For the tertiary digital portion that is in quadrature to the analog signal it is at ~-50dBc, add in another ~20dB of protection offered by it being 90° out of phase of the analog carrier and that the analog component is at ~-8.5dBc, offers a total protection ratio of >60dB to the analog component from the tertiary digital sidebands. The protection to the analog signal from the tertiary sidebands can vary at the receiver depending on the phase/delay symetry between the upper and lower sidebands for both RF and IF filters. It would not be uncommon for well designed analog radios to offer an additional 10dB to 15dB of protection for the analog signal from the tretiary sidebands for an overall prtection ratio of 70dB to 75dB. For the secondary digital sidebands that are at ~-41dBc, add in the ~20db of protection offered by the average narrowband response of most radios and that the analog audio is at ~-8.5dBc, also provides a >50dB protection ratio to the analog receiver from the secondary digital sidebands.

It should be noted that for all the digital sidebands the primary ones that are furtherest away from the carrier are the strongest while the tertiary ones that occupy the same bandwidth as the analog component are the weakest. The IBOC digital levels have been designed to provide maximum protction to the analog component of the hybrid signal while shifting the interference problem to 1st and 2nd adjacent channels. As a result the distribution of the energy spectrum of an IBOC signal is the exact opposite of a full bandwidth analog signal and creates a completely different interference problem. It is the characteristics of the analog signal where, a vast majority of the energy is contained in the bass, a fair amount in the midrange and much less is contained in the higher frequencies, that has allowed as many AM stations to be crowded together as we have today. If it was the characteristics of an audio signal where most of the energy was in the higher frequencies and very little was in the bass then the station spacing would need to be at least double of what it is today and yet this is the energy distribution charateristic of the hybrid IBOC signal.

The Need to Provide an Equivalent Protection to Adjacent Analog Transmittions

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On analisys of these levels of the digital sidebands it demonstrates that iBiquity recognizes the need for good protection to the analog portion of a hybrid IBOC signal from its own IBOC sidebands. It also demonstrates the need to provide the same level of protection to a 1st adjacent channel's 2.5mV/m contour. Since the primary and secondary IBOC sidebands fall within the ±5KHz bandwidth of a 1st adjacent signal, and that typical narrowband IF filters offer little protection for this frequency range from the IBOC sidebands, nessitates the need to provide at least a full 60dB of protection to a 1st adjacent station's signal at its 2.5mV/meter contour from the IBOC sidebands to provide a similar level of protection that the iBiquity technology provides to the analog portion of the hybrid IBOC signal.

Interference from Multiple IBOC Transmittions

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Now this is only the interference from one station transmitting IBOC. Consider four stations transmitting IBOC, two 10KHz above and two 10KHz below, to a station's ±5KHz analog signal. To keep things simple let's consider that these four IBOC transmittions have equal signal strength within an anaolg station's 2.5mV/m contour. Since the IBOC signals have a characteristic similar to white noise and that the four signals are uncorrelated to each other they will increase the background noise by minimum of 6dB to the analog signal. This would require that those four IBOC signals will need to reduce the interfering sidebands by at least 6dB. As more IBOC transmittions come on line levels of the IBOC background noise will increase and IBOC sideband levels will have to be decreased accordingly in order to maintain a 60dB protection ratio below the analog station's audio level within the stations 2.5mV/m contour. It will be situations like this that will facilitate the need to protect analog broadcasts if IBOC testing is to continue for nighttime use to maintain the same level of performance analog radios have enjoyed in the past. While the 2.5mV/m contour mostly represents the local area coverage it is probably necessary to set protection ratios for the distant and and fringe coverage maps also. For the distant coverage at the 0.5mV/m contour a 46dB protection ratio could be set and for fringe coverage at the 0.25mV/m contour a 40dB protection ratio set. Now these protection ratios may be high in some cases and in the actual field where the existing analog background noise is much greater then the protection ratios could be reduced while still maintatning the same level of quality that analog reception has enjoyed in the past. These protection ratios are for both groundwave and skywave interference at night to groundwave coverage and it would also be a good idea to provide similar groundwave protection ratios for daytime use. With the unpredictability of skywave propagation there could be at times intollerable levels of interference that could severly affect an analog stations groundwave audience and this must be taken into account.

A New Measurement Technique is Needed

Much of the determining factors in deciding whether or not IBOC should be approved for nighttime use and at what levels is largely subjective to the psycho-accoustics of the human ear. While the IBOC signal can be classified as a white noise type of signal in the fact that it has a continious level across the occupied spectrum, it has a sharper, piercing, more objectional characteristic often refered to as a modem, buzz saw or high pitch whine like sound when received on an analog receiver. The potential nighttime interference problem when a majority of stations transmit IBOC could be compaired to having several high powered damped wave spark gap transmitters operating throughout the continental U.S. within the AM broadcast band. The noise characteristics of this type of transmittion occupied a very wide spectrum and basically allowed only a few to transmitt at once and caused major interference problems at the receiver. It is obvious why these types of transmittions were made ILLEGAL and each IBOC transmitter is like a narrow band version of a spark gap transmitter when it comes to interference. With many IBOC transmitters spread across the AM dial this has the potential generate the same ill effects for analog reception. Whether or not IBOC receivers could operate adequately at night under these types of conditions remains to be seen while the potential to destroy analog reception is great. It should be noted that even for micro power 100mW Part 15 transmittions that "Class B Damped Wave" transmittions are PROHIBITED in the AM band. 100mW transmittons have very limited range but the negative impact that a damped wave transmittion has on an analog AM receiver at even greater distances exists. The interference effect is somewhat similar to the impulse noise present from a car's ignition systems that is sometimes picked up by the radio. Car manufactures are required to keep this to a minimum by using high resistsnce spark plug wires to keep the the wires from acting like mini transmitting antennas.

While these protection ratios are based on existing measurement techniques, a more fuzzy logic approach needs to be developed based upon the preception of the human ear in regards to how obnoxious IBOC will be over the typical background noise that now exists from full time analog transmittions. Under all circumstances IBOC interference must yield to protecting existing analog broadcasts. To put it simply, in all groundwave listening areas, local, distant, and fringe markets, the IBOC signal should not be recognizeable within the normal analog background noise and should blend into it regardless of whether a wideband or narrowband radio is used within the available received signal strength to background noise. Obviously in most cases a wideband radio should not be used in a fringe market and the IBOC signal will not need to deal with interference issues for widebband radios under these circumstances but if fair signal reception is possible in a fringe market with a narrowband radio then IBOC interference levels will have to be controlled. Likewise if good reception is possible in local and semi distant markets for medium bandwidth radios then the IBOC signal must not cause any signal degredation. The listener, under no circumstances should suffer any loss in his/her listening experience of analog broadcasts that exists in a complete analog environment.

Do not be dazzled by the techno-speak in the Glen Clark petition when it comes to D/U protection ratios as this will not protect existing analog transmittions in most cases. It is just the characteristics of the type of modulation that IBOC uses that even though it may be within the NRSC mask its overall energy level is much greater. The typical analog signal has little enregy in the upper audio range as compared to the bass and mid frequencies when eq levels are adjusted for a good overall sound. As a result the typical duty cycle of the higher frequency energy present in cymbals or other types of percussion instruments is lower when weighted over a period of time. During skywave interference it would take the sum of many analog stations to generate a composite background noise that would have a continuous energy level just below the NRSC mask but this is what just one IBOC transmittion would create. How many analog stations does it take to generate the background noise produced by one IBOC transmittion? Given the unpredictable characteristics of skywave interference this is not imediately known but it could be in the range of 5 to 50 or maybe even more analog stations for one IBOC station depending on the type of program material on the analog transmittions. Using the present measurement techniques for the NRSC mask does not take into account these issues. A more accurate approach would be to measure the average energy level present in an analog signal in the higher audio frequencies averaged over a period of time, maybe an hour or so, for typical music and voice program material. Once this measurement is obtained a separate mask could be set for IBOC transmittions that reflects these energy levels while also taking into account the aural impact to the human ear for the IBOC type of signal if this restriction needs to be even greater. This measurement technique may show that regardless of the protection levels for local, disdant, or fringe contours that IBOC sidebands will need to be so many dB below the typical analog background noise in order to provide good protection for analog reception.

Use of IBOC in the Expanded Band

As for the expanded band the Commission granted stations a move to it in order to reduce the overcrowding in the existing AM band. One of the incentives to move in the promotion of AM Stereo in the expanded band was that stations intending to broadcasting AM Stereo would be given first choice over a station that didn't. The intended effect was to promote faltering AM Stereo as a result of the indecision of adopting a single standard with the possibility to have higher fidelity wider dynamic range broadcasts available. How many stations who promised AM Stereo and delivered is another issue but there is probably more higher fidelity stereo signals per capita in the expanded band than in the existing band although I do not have any statistics on this. The licenses for these stations are 10KW day and 1KW at night and in most cases station assignment was handled well to help prevent the interference issues associated with the existing band. As a result many listeners of these expanded band stations enjoy higher quality broadcasts on wideband radios. Even though that in most cases interfernce is kept to a minimun during an all analog transmittion situation it is the constant "on" charasteristic of the IBOC signal that has the potential to create interference problems that didn't exist previously. Contrary to the general belief that medium and wideband radios are not available the Big Three, Japanese and European auto makers have provided AM Stereo radios in cars for more than a decade. Many portable and home receiver models were also manufactured and one radio by GE that is wideband mono is still being made. Most of these radios do find themselves in the hands of those who use them solely for their wideband and/or stereo performance. Introducing IBOC into the expnaded band will have a greater negative impact on reception since this band is generally quieter at night and the wideband radios will pick up more of the IBOC hash than a narrowband radio. In order to maintain the existing performance of these radios with the lower background noise of the expanded band the IBOC sidebands may need to be reduced even more than what would be required in the existing band. Extra attention needs to be paid in allowing the use of IBOC in the expanded band in order to prevent the degredation of existing analog service under meduin and wideband reception.

Lack of Responsibility for 1st & 2nd Adjacent Interference

Although the Glen Clark petition does not mention any responsibility about protecting 2nd adjacent stations from interference based on that most radios are narrowband is narrowminded since there are many radios that have medium bandwidth that preform well for local and semi distant nighttime use. These radios offer higher fidelity than a narrowband model but not so wide as to pass annoying high frequency background noise. 2nd adjacent interference from IBOC sidebands has the potential to cause harmful interference for medium bandwidth radios and demonstrates a need to provide protection ratios similar to 1st adjacent stations. In the current assignment of frequencies and station's locations, 2nd adjacent stations will be closer to an IBOC staion than 1st adjacents. By completely ignoring the 2nd adjacent interference issue the potential to cause harmful interference is much greater than it would be for 1st adjacents based on the closer distance. Interference to 2nd adjacent stations must also be controlled as to not to increase the auditory preception of background noise over what it would be if a potential IBOC station was trasnmitting full bandwidth analog. Also mentioned in the petition was "Regrettably, both computer models and field tests have shown that nighttime use of the AM IBOC system can, _in_certain_instances_, lead to intolerable levels of interference to the ongoing operation of legacy analog broadcasting for first-adjacent channel stations. Such digital-into-analog interference is an obstacle to blanket adoption of the AM IBOC system." With the overall tone of this petition for reconsideration being pro IBOC this statement could most likely be interpreted as that some stations must be sacrificed for the promotion of IBOC. If the interference is bad enough it would be akin to the jamming of the Voice of America. Allowing intolerable levels of harmful interference opens up the possibility to financially damage an analog station's revenue stream and in some cases cause siginfigant signal degredation as to put the station in financial jepoardy as if a lot of the smaller stations aren't close to this situation already. For a smaller station that is operating basically hand to mouth this can be the straw that breaks the camel's back. This has the potental to open the door to scores of lawsuits if IBOC at night is approved in its present state. Under these circumstances victimized stations should be provided compensation by the interfering station for any loss of income and any punitive damages and/or reduce/terminate the IBOC transmission. If any type of IBOC is approved at night then a fast track resolution system should also be approved to allow those stations who suffer interference a quick, easy, no cost means to provide them compensation or reslove interference issues before financial harm occurs.

Use of IBOC by Class A Stations

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For higher power Class A Non-Directional 50KW stations, commonly known as clear channel stations, provide a signal ten times as powerful or greater as most other stations and the need for IBOC for better signal qualiy is really unnecessary. For the majority of the listening audience the analog signal even in wideband mode at night sounds good enough to provide a very high quality signal. In my area we have one 50KW station, although it is a Class B directional, at over 50 miles away it provides excellent signal quality at night with an audio response out to 10kHz on a wideband radio. For these high power 50KW stations that use IBOC, this has the potential to cause harmfull interference to a much greater number of 1st and 2nd adjacent stations than stations at one tenth the power. The need to provide protection to existing analog receivers far outweighs the small if any appreciable improvement in signal quality that IBOC may provide for these high power stations. It would be inadviseable to allow these powerhouse stations to implement IBOC unless the IBOC sidebands are reduced to a level at which a 5KW station would use at night.

Discriminary Interference Solutions

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One of the proposed solutions to help reduce interference is to reduce one or both of the IBOC sidebands, completly eliminate one of them and in some cases not allow a station to use IBOC at all. Setting regulations where some stations are allowed to use IBOC at full power, some at half power, and others not at all will set up a situation where if IBOC is successful at increasing revenue, those that can't use it at full power or not at all will mean that some stations will suffer loss in coverage from reduced power and others will be left behind. A policy should be set to provide all stations the opportunity to use IBOC equality or not at all.

Conclusion

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Since one of the goals for approving the nighttime use of IBOC is to prevent harmful interference to the existing analog service, the use of the existing measurement techniques and broadcast mask limitations to set IBOC sideband levels are not adequate to provide an accurate calibration level to prevent a negative aural impact to the human ear. When trying to compare the impact of a digital signal received on an analog radio with the same measurement techniques is like comparing apples to oranges. Analog and digital signals do not mix when it comes to the preception of the human ear. Everywhere else in the radio
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spectrum, even the ham bands, great care is taken to ensure that different types of signals are not co-mingled in a manner that would cause harmful interference. If, after all these issues outlined above are taken into account, it shows that very few if any stations can use IBOC at full, reduced power or at all then this will show that IBOC is not a workable solution for the AM band at night. One of the requirements when AM Stereo was being decided upon the Commission was very concerned about compatibility with existing envelope detectors and as a result a standard was eventually chosen that offered high compatibility with existing receivers and the best stereo performace under most conditions. It is the expectation that the Commission will use as strict of guidelines when determining whether or not to allow IBOC at night and at what levels while maintaining existing analog performance when it comes to interference from IBOC transmittions.

Respectfully submitted

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